

1. New and Enhanced Functions

1.1 New functions

The revised version of AFDEX V16R01 is released at October 1st, 2016. The following functions are fortified.

1.1.1 Dies with shrink fit and elastic deformation

The original version of AFDEX V16R00, was not able to simulate the coupled process of die simultaneously effected by the shrink fit, heat transfer and elastic deformation. With this new revised release, the coupled process of die structural analysis can be simulated in consideration of thermal, mechanical and shrink fit loads all together.

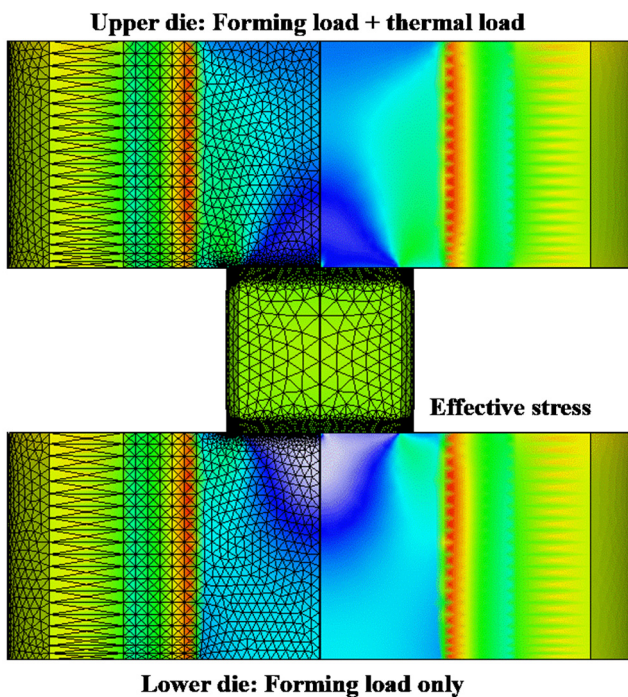


Fig. 1 A synthetic analysis of an upsetting process

1.1.2 An iterative analysis between particular steps

Figure 2 shows an example of drawing process using iterative analysis scheme to trace the temperature change in the plug and dies. The function allows an iterative analysis scheme after updating the die temperature at a particular time step.

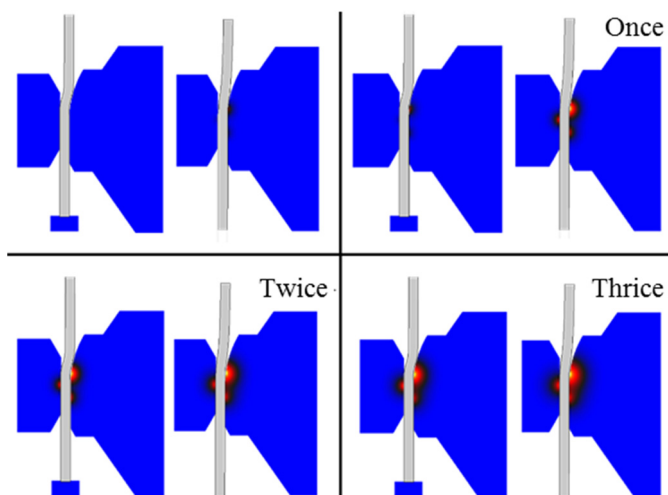


Fig. 2 An iterative analysis in the drawing process

1.1.3 Function considering elastic deformation of press

An analysis of an elastic deformation induced in the press is sometimes vital to the precise expectation of the forming loads. The forming load at the final stroke of closed forging process is abnormally increased on the common assumption of rigid body press. The remedy of considering elastic deformation at the same time plays a meaningful role in solving such kind of problems.

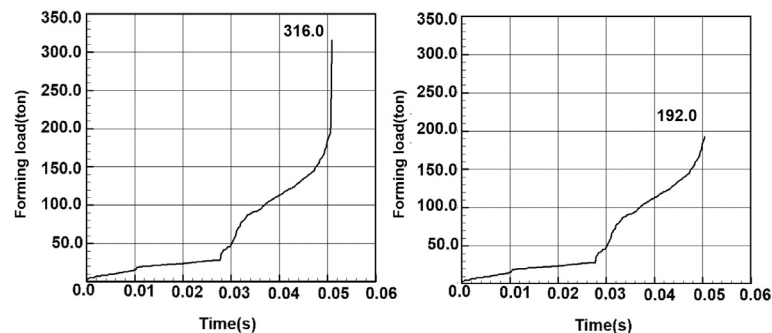


Fig. 3 Forming loads with an elastic press deformation

1.1.4 Optimization function coupled with HyperStudy of Altair

The function of optimizing pivotal parameters in the forging process is now available, as AFDEX is now coupled with Altair's HyperStudy. Any user who is already exposed to the AFDEX input data structure can easily access to the function of parameter optimization.

a) Followings are basic information about the forging process for the transmission gear blank to be optimized:

- Stage: 2-stage hot forging
- Material: SCr420H
- Press: 2500 ton, mechanical
- Friction: $\mu = 0.2$

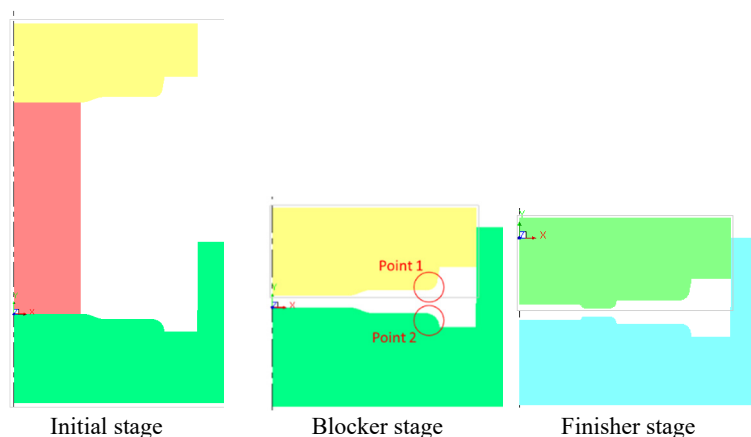


Fig. 4 Schematic diagrams for the forging process

b) The problem definition and conditions are as follows:

- Design variable: radii of point 1 and 2
 - Point 1: 2~13 mm (0.5 mm incremental), Initial value: 6.0 mm
 - Point 2: 2~8.5 mm (0.5 mm incremental), Initial value: 4.0 mm
- Constraints: forming load in the blocker process < 1600 ton
- Objective function: Maximum load of finisher process
- Algorithm: GRSM (Global Response Surface Method)
- Maximum repetition number of analysis: 100 times
- Initial sample points: 4 points

c) Optimization results are as follows:

- Forming loads with initial values at Point 1 and Point 2 Blocker and finisher: 1800 and 2030 tons, respectively
- Optimized design variables and the resulting output Radii of point 1 and point 2: 11 and 7.5 mm, respectively
- Forming load in the blocker process: 1595 ton
- Forming load in the finisher process: 1589 ton

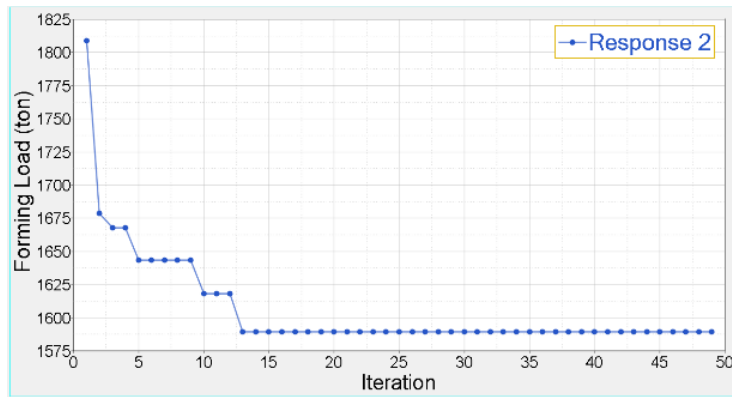


Fig. 5 Forming loads versus iteration

1.2 Enhanced functions

Several functions are improved and summarized below.

Table 1 List of improved functions

Dim.	Enhancements
2D	<ul style="list-style-type: none"> - An enhanced local mesh density - An option included for mesh regeneration - Convergence improved in the plate forging process - Editing function for allowable volume improved - Realistic grip handling in the drawing process
2D / 3D	<ul style="list-style-type: none"> - Default load limit specified - Die deformation due to shrink fit possible
3D	<ul style="list-style-type: none"> - An improved check for shrink-fit ring and die insert - Velocity enforcement timing improved - An improved grip model in the roll forging

2. Recent Activities

2.1 MFCAE 2016

MFCAE 2016 was held in Jeju Island, Korea on August 18th to 19th, 2016, covering a wide range of innovative metal forging technologies with 19 oral presentations and 62 poster presentations. The topics have come from various fields including educational use cases, academic researches, and a detailed introduction to new and enhanced functions embedded in AFDEX.

Participants were especially encouraged to prepare much more poster presentations so as to cover the difficulties stemming from language problem, limited time and communicative inefficiency in each oral presentation. Meanwhile, new ingredients such as dinner of standing buffet type and bus tour around Jeju's scenic sites were pleasing aspects of the events, for they enabled engineers and researchers to have chances of close intercourse for sharing experiences together with some nice memories and funs. See Figs. 6 and 7.

2.2 GISPAM 2016 and GKS-ASEAN

This summer MFRC has operated the international education program of GISPAM 2016 for five weeks stretching from July 18th to Aug. 20th. GISPAM stands for GNU International Summer Program of AFDEX and other engineering software for the state of Mexico, and corresponds to a short term educational course fully sponsored by the state of Mexico, in which each year 20 Mexican university students have been involved in the subjects of mechanics,

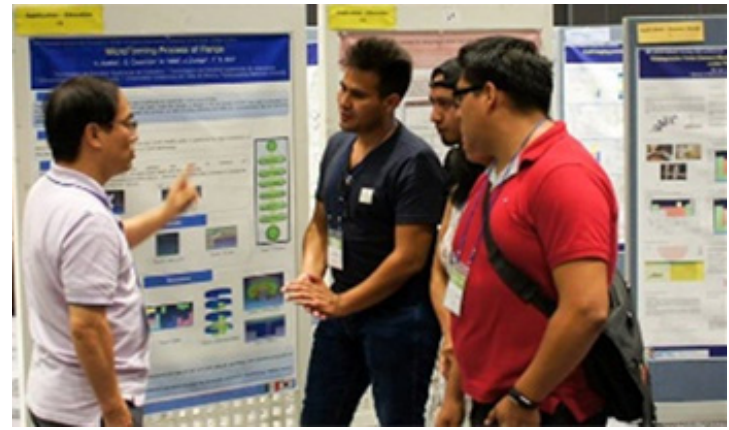


Fig. 6 Poster and Q&A session



Fig. 7 MFCAE 2016 and its main hall

CAD, and the 4 engineering softwares of AFDEX, Z-CAST, MAPS-3D and a new entrant of RecurDyn this year. GISPAM originally started from 2014 for three weeks of time span, and then for 5 weeks in the 2nd year, and up to this year it is steadily evolving as an well-established model of international academic cooperation, which is reflected from the fact that those 20 students showed their program satisfaction index of 98 out of 100 in the program evaluation survey after the course.

Meanwhile, a program of GKS-ASEAN quite analogous to GISPAM was also processed for 6 weeks sponsored by Korean government nearly at the same seasonal time, in which 24 qualified students from 7 ASEAN countries participated with their academic background of mechanical engineering in their university. The main structure of GKS-ASEAN was very similar with GISPAM, so that 24 ASEAN students, 20 GISPAM students and 24 GNU students enrolled in the summer session, they all could enjoy the opportunity of mingling together in the same class, furtherly enabling energetic and passionate youngsters to become close friends and share precious time of international social exchange.



Fig. 8 Participants of GISPAM and ASEAN 2016 together with GNU students enrolled in the summer semester for the subjects of Introduction to FEM and Manufacturing Technology



Fig. 9 GISPAM 2016 / ASEAN 2016, Class of AFDEX (upper side) and some selected posters presented in MFCAE 2016 (lower side)

2.3 AFDEX launch workshop in India

An AFDEX workshop as one of launch events for Indian market was at last held in Pune, India from Jul. 20th. In the earlier part an experience education was offered for engineers, while the later part included two seminars done by Mr. Y. G. Choi from Samwoo and prof. M. S. Joun. Also, pleasant banquet was prepared to give participants the chance of exchanging their experiences and encouraging to promote friendship.



Fig. 10 AFDEX workshop in India

2.4 Altair Technology Conference 2016 Korea

On Sep. 23rd, 2016 Mr. Min-Cheol Kim, one of team managers at MFRC, attended the event of 2016 ATCx held by Altair Korea at Conrad Seoul Hotel, whose slogan was “Key to Smart Manufacturing, CAE and subtitled “Manufacturing in the future seen by CAE”. (Link: <http://blog.altair.co.kr/38926>).

During the RADIOSS session Mr. Kim presented meaningful research results tilted as ‘An optimization study on geometric parameters for forging dies based on AFDEX and HyperStudy’ together with AFDEX introduction. See the details in section of 1.1.4 above.

2.5 A special lecture for KSTP and KSHT

On Sep. 28th, 2016 Prof. Man-Soo Joun delivered a special lecture at Kumoh National Institute of Technology jointly held by KSTP (Korean Society for Technology of Plasticity) and KSHT (Korean Society for Heat Treatment). The lecture dealt with crucial features involved in the process design of automatic multi-stage forging processes based on various applications with simulation results.

2.6 Attendance at LS-DYNA & JSTAMP Forum 2016

Prof. Man-Soo Joun additionally plans to attend to the JSOL LS-DYNA & JSTAMP Forum for two days of Nov. 8th to 9th in Nagoya, Japan, delivering a presentation focused on the most recently fortified simulation technology of plastic flow and heat transfer analyses together with die’s elastic deformation considered.

Meanwhile as one of the accompanied events MFRC is going to operate a Promotion Booth at the 6th AFM 2016 (Asia Forging Meeting) in Tokyo, which is also to be followed by MFRC’s visits to major Japanese user companies including Asahi Sunac Corp. and a Gubota Group company including newly joined user companies.

2.7 Papers to 2016 KSTP Fall Conference

The state-of-art simulation technologies for precision forging were presented in the special session during the 2016 KSTP Fall Conference held on Oct. 6th to 7th, which was titled “Precision Forging Simulation Technology and its Applications”, whereas KSTP stands for Korean Society for Technology of Plasticity.

As totally 12 papers written by MFRC’s developers group were given by MFRC in the conference, they are expected to give users various sorts of insight toward precision forging technology for simulations and special analyses with elastic deformation considered in the dies and presses.

2.8 2nd edition of AFDEX’s theoretical book was published

The second edition of a text book entitled “Advanced Solid Mechanics and Finite Element Method” written by M. S. Joun, W. J. Chung, S. H. Chung and M. C. Lee was recently published by Jinsaem Media in Korea, involving most mathematical and theoretical backgrounds and meaningful applications of AFDEX. The authors are all major developers of AFDEX and thus this book may be regarded as the theoretical book of AFDEX. The book was written in Korean and it will be translated in English or other languages sooner or later.

It can be used as a text book for advanced engineering mathematics for junior students or introduction to FEM and/or advanced solid mechanics for senior or graduate students. We need foreign researchers who want to make it more fruitful or localized for a text book in their countries as well as the theoretical book of AFDEX.

3. New Recruit

From this October we are happily to observe Mr. Renganathan Sekar to start his new work career at MFRC. He previously visited the MFRC exhibition booth displayed at Hannover Messe in Germany last year, expressing his sincere interest in AFDEX and strongest desire to work for MFRC Inc. In order to properly meet the strong needs for qualified and professional labor forces raised by the currently globalized several industrial fields, MFRC decided to let Mr. Sekar join the front business line of AFDEX around the world.

- Name: Mr. Renganathan Sekar
- Academic background: Mechanical Eng., Master, RWTH Aachen University
- Detailed major: CAE and its application
- Expected work field: International cooperation with Altair Software evaluation and development, Customer support

Meanwhile MFRC is always open to the young engineers with full of passion and energy.

4. AFDEX Top Use Cases recommended to ALTAIR

The followings are seven use cases, recently recommended to Altair and displayed in the Altair APA homepage to promote AFDEX. AFDEX best users can ask us to recommend them as the AFDEX top use cases or any other contributors. MFRC is always ready to evaluate the companies and applications in duly course before final decision for recommendation.

AFDEX Top Use Cases

Manufacturing Software by MFRC, Inc.



Metal Flow Line & Scrap Optimization in Forging

Challenge

- Optimize metal flow lines
- Minimize the scrap volume
- Develop new automatized process with no failure

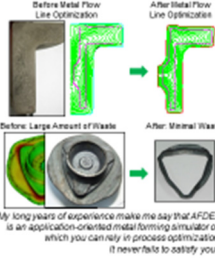
Solution

- AFDEX used to predict metal flow lines
- AFDEX provides higher accuracy to eliminate or minimize trial-and-error process.

Benefits

- AFDEX excludes failure at the early stage of process design especially in the conventional cold or hot forging processes.
- AFDEX allows process design engineers to achieve optimal metal flow lines with maximum yield and minimal scrap.

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Mr. Jae-Hyun Chung
SEN. Manager
Schaeffler Korea



Shorten Lead Time & Cost in Forging Process

Challenge

- Minimize the lead time and cost in developing difficult forging process
- Find an acceptable process design with no local material folding, which is almost unavoidable when depending on trial-and-error approach.

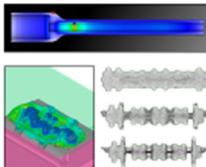
Solution

- User-friendly functions in AFDEX help process design engineers become agile users through ways of simple operation.
- Automatic simulation capability for multi-stage forging processes enables users to analyze the whole simulation with the least intervention.

Benefits

- Minimizes development time and cost
- Makes it possible to turn very tough metal forming processes into economically competitive ones with no failures.

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Mr. Young-Hyo Jun
Vice-President
Jinhap, a member of GFA



Plate, Sheet & Clad-Metal Forming

Challenge

- Solve sheet or plate forming processes of clad-metal with titanium skin and aluminum base
- Create layered mesh system
- Predict fracture phenomena and accurate product dimensions

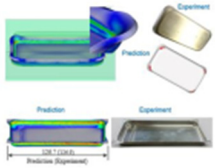
Solution

- AFDEX offers a special routine for generating layered finite element models with tetrahedral elements, which can be effectively employed in revealing fracture at the corners or vicinities.

Benefits

- AFDEX can be a powerful solution provider in solving plate or sheet metal forming processes, especially for clad-metals using solid elements.
- AFDEX has special functions for processes such as blank holding force-exerting die, spring attached die, layered mesh generation scheme, etc.

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Dr. Hong-chul Hyun
Senior researcher
Global Technology Center
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You can obtain more detailed information from the link below.

1. Altair APA homepage

<http://www.altairhyperworks.com/partner/AFDEX/>

2. AFDEX Top Use Cases

http://www.altairhyperworks.com/ResourceLibrary.aspx?keywords=&altair_products=&partner_products=afdex&product_service=All&category=Case%20Studies&order_by=date_created&order_by_da=desc

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Forging Process Renewal / Optimization for Automation

Challenge

- Renew the conventional process designs
- Optimize the process design in terms of robustness
- Minimize the cost with enhanced quality

Solution

- Improve conventional process designs in consideration of automation by simulating them in a fully automatized way
- Minimize the scrap generation and conduct the design for stable scrap gripping

Benefits

- AFDEX minimizes the burden of development cost which replaces manual products with automatized ones with no additional cost.
- AFDEX helps improving the stability of process and quality of forgings, leading to the world-class competitiveness in hot forging of hubs, bearings and etc.



Mr. Deuljong Yoo
Executive Director
Dongseon Forging



Precision Forging of Large Automotive Parts

Challenge

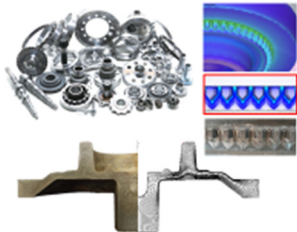
- High value-added forging parts for automotive industry
- Net-shape forging of large gear-like parts with no empirical knowledge available

Solution

- Engineering together with process optimization might be accomplished by counting on AFDEX of high accuracy predictions.
- The cost for product development and its tooling as well can be minimized.

Benefits

- Much earlier than expected the new business of net-shape forging turned out to be soon stable for large gear products.
- The company of Hanho has successfully equipped their engineers with state-of-the-art technology and creative research capability in the field of high-precision auto-transmission parts.



Dr. Hokeun
Executive Director
Hanho Automotive Co.



Innovative Non-Standard Automatic Multi-Stage Cold Forging

Challenge

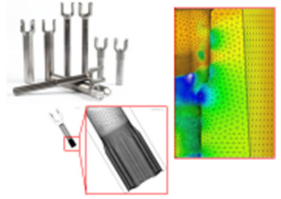
- Develop highly value-added auto-parts, i.e., non-standard parts including yoke parts
- Develop micro-forming parts for ABS parts

Solution

- Increase die life-span with minimized die stresses
- Encourage process design engineers to challenge creative and innovative process designs

Benefits

- AFDEX paves such a way for process design engineers as to make them more active in developing new process for new products.
- Customer companies has a big confidence in crediting forging companies as product quality guarantors.



Mr. Taemin Hwang
Executive Manager
Sungeon FO-S&A



Innovation in Die Making for Customers

Challenge

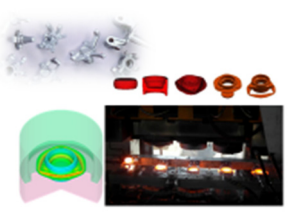
- The more technological advances in forging companies, the more user-friendly process design software is in need.
- Global business is more attractive especially in forging industry when process designs can be easily optimized.

Solution

- More opportunities can be secured when the most user-friendly forging simulator such as AFDEX is hired.
- Approaches are to be made through optimizing many chronic problems by close collaborations with AFDEX developers

Benefits

- International standards and requirements are fruitfully met in forging process design as well as the die making.
- Collaborations with AFDEX technicians greatly enhances the company's level of understanding global technological trends and applicative caliber towards customers.



Mr. Younggil Choi
President
Samwoo

